Appendix A−Collaborating Projects

North Pacific Research Board is cooperating with other funding organizations to formally include the existing projects listed here in the Arctic ecosystem program. These projects will collaborate with projects funded through this call for proposals; the lead Principal Investigators will participate in annual PI meetings, share preliminary data with collaborators, and contribute intellectually to addressing the core hypotheses of the funded research program. Proposers are encouraged to describe how their research would use the data and expertise provided by existing projects. Existing projects are not intended to constrain the direction of the new research projects proposed.

Bering Strait mooring program

Funding provided by National Science Foundation

A physical oceanographic year-round mooring program has been maintained in the Bering Strait since 1990, with measurements for other disciplines being incorporated in recent years. For an overview of this prior mooring and accompanying section work, please see Woodgate, Stafford and Prahl (submitted) http://psc.apl.washington.edu/HLD/Bstrait/BStraitMooringSynthesis2015.html. Under National Science Foundation Arctic Observing Network (NSF-AON) funding, a set of 3 Bering Strait moorings will be maintained in the strait from summer 2014 to recovery in summer 2018, with annual mooring turn-around cruises, which (as time and weather allow) run accompanying CTD sections (no water samples) in the strait.

Lying all in US waters, the three mooring sites are:

- A2 (center of US channel);
- A4 (east side of US channel, measuring the Alaskan Coastal Current); and
- A3 (central to the strait about ~ 35km north of the Diomede Islands, at a site found to give a useful average of the flow through the Russian and US channels of the strait).

The data from the 3 moorings sites (combined with some satellite data) allow hourly quantification of the volume, heat and freshwater fluxes through the strait and an estimate of the physical water properties of the mean flow, of the waters in the US and Russian channels, and of the Alaskan Coastal Current. These data are being combined with modeling results (Heimbach and Nguyen, MIT) and traditional knowledge (Raymond-Yakoubian, Kawerak, Inc) to yield a fuller understanding of the properties of the throughflow.

Each mooring carries lower level (~45m) and upper level (~17m) temperature and salinity sensors and an upward looking ADCP measuring water velocity in 2m bins to the surface, and some measure of ice thickness and ice velocity. (All instruments are internally recording, thus data are only available after recovery, and data calibration.) All calibrated data and data products are available via our website (psc.apl.washington.edu/BeringStrait.html), ACADIS and NODC. See e.g., the 2014 cruise report for full details, including mooring locations, cruise maps, and preliminary results (Woodgate et al., 2014, Bering Strait Norseman II 2014 Mooring Cruise Report, 73 pp, available at http://psc.apl.washington.edu/BeringStrait.html).

For further details (e.g., re data collaborations or possible additions to the moorings), contact Rebecca Woodgate.

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Arctic Marine Biodiversity Observing Network (AMBON)

Funding provided by Bureau of Ocean Energy Management, National Oceanic and Atmospheric Administration, and Shell

This study will build on emerging distributed biological observatories (DBOs) by developing a prototype ecosystem-based marine biodiversity network over offshore oil and gas lease areas in the Chukchi Sea, monitoring multiple trophic levels and species, and informed by historical data and past modeling efforts. Such a network will: expand upon planned and recently-launched observing sites, systems, and programs; employ innovative techniques for data discovery and methods that dynamically interrelate data sets and add value to existing monitoring data; collaborate with the U. S. Integrated Ocean Observing System (U.S. IOOS) participants and funding agencies to optimize data management and modeling capabilities.

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Aerial Survey Arctic Marine Mammals (ASAMM)

Funding provided by Bureau of Ocean Energy Management

Bowhead whales, gray whales, beluga whales, Pacific walrus, polar bears, bearded seals, and other species of ice seals are known to seasonally occupy the Chukchi Sea. All of these species are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Having a good understanding of the seasonal distribution, relative abundance, and habitat use of marine mammals in the Chukchi Sea is fundamentally important to evaluating the potential environmental impacts associated with oil and gas exploration and development and other anthropogenic activities. Aerial surveys of marine mammals are an efficient tool because they offer quick coverage of large marine areas. Past surveys are available for comparison with new data to assess whether changes in distribution or abundance have occurred since the earlier surveys were completed.

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Chukchi Acoustic, Oceanography and Zooplankton Study (CHAOZ)

Funding provided by Bureau of Ocean Energy Management

Baleen whales are subject to changes in environmental variables such as oceanographic currents, sea temperature, sea ice cover, prey availability, and anthropogenic impacts. Extreme ice-retreat and climate warming in the western Arctic over the last decade is anticipated to lead to changes in species composition and distribution, evidenced already through local knowledge and opportunistic observations. Hanna Shoal in the northeast Chukchi Sea is an area of special biological concern bordering the boundary between Chukchi and Arctic Ocean waters and its importance bowhead, gray and other whales, as well as walruses and ice seals, is not well known. The shallower waters of the shoal have long been known as traps for grounding of sea ice, and the creation of reoccurring polynyas. In most recent years, floating pack ice in summer persists in this area longer than elsewhere in the Chukchi, often surrounded by open water even to the north. Biological "hot spots" in the Chukchi Sea are thought to be related to coupled pelagic and benthic productivity.

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Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas

Funding provided by Bureau of Ocean Energy Management

This study is a continuation and expansion of the existing surface circulation study within the northeast Chukchi Sea. Prior to 2009, surface current observations on the Chukchi shelf were extremely limited. Through a joint Industry/BOEM supported study, the University of Alaska Fairbanks (UAF), Coastal Marine Institute began measuring surface currents during the open water period on the Chukchi shelf beginning in September 2009 with the deployment of long range, High Frequency (HF) radar systems located at the villages of Barrow and Wainwright. In 2010, coverage was expanded to the southwest to include additional offshore lease areas. The surface current data was supplemented by water column profile data collected by Slocum Gliders. Acoustic Doppler current profilers (ADCPs) were also deployed across the Alaska Coastal Current at the head of Barrow Canyon to assess the annual flow regime, the connectivity between surface and subsurface currents during the open water season, and the changes in subsurface currents beneath the mobile pack ice and lead system during the winter months. This study will expand present efforts to improve understanding of the flow regime and shelf dynamics between the inner and outer Chukchi shelf, the exchange of waters between the Chukchi Sea and western Beaufort shelf through Barrow Canyon, and the upwelling of Atlantic Waters.

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Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area

Funding provided by Bureau of Ocean Energy Management

This study proposes to develop a broader understanding of abundance and distribution of demersal and pelagic fish, crab, and lower trophic communities needed to evaluate and mitigate the effects of offshore oil and gas development. Formerly, several BOEM funded studies have identified temporal, seasonal, and spatial gaps in data on fish in the Chukchi Sea near the lease areas. This study is designed specifically to fill these information needs. It will build upon recent information on invertebrate communities in the Chukchi offshore lease area obtained by the 2009 study "Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemistry and Benthos (CAB)." It will create a similar survey design such that data sets are compatible, comparable, and extend the time series and contribute to further knowledge of pelagic fishes in the northeast Chukchi Sea.

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Marine Arctic Ecosystem Study (MARES)

Funding provided by Bureau of Ocean Energy Management, Office of Naval Research, Shell, U.S. Arctic Research Commission, U.S. Coast Guard, and ArcticNet

This project intends to collect additional comprehensive and integrated information in the Arctic on the spatio-temporal distribution of fundamental physical, biological and chemical variables, their associated interactions and regulating mechanisms, as well as the distribution of cultural and subsistence resources which sustain local communities. This information will be used to better understand and assess arctic ecosystem sensitivities and vulnerabilities as a function of space and time to aid decision-makers in minimizing the impact of the oil and gas industry on the Outer Continental Shelf. The resulting information will support NEPA analyses, environmental impact assessments, in validating models, as well as in Oil-Spill Risk Analysis. Additionally, these observations and improved description and understanding of biogeochemical and physical interactions will aid to improve the accuracy of model simulations and forecasts. Coordinated observational and modeling efforts will produce information that will be analyzed from different perspectives: a) ecosystem understanding and environmental protection, b) climate change and monitoring, and c) Oil-Spill Risk Analysis.

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Hanna Shoal Project

Funding provided by Bureau of Ocean Energy Management

The Hanna Shoal Project complements the earlier BOEM-supported COMIDA CAB project. Field work for the Hanna Shoal Project is complete and the PIs are synthesizing the results.

Hanna Shoal is a shallow topographic feature of the northeastern Chukchi Sea that lies about 100 mi northwest of Barrow, Alaska at latitude 72° N. Water depths on various parts of the Shoal are as shallow as 20 m (60 ft), compared to 55 to 60 m (180 ft) on the surrounding seabed. The deeper flanks of the shoal are biologically rich, as reflected in the historically high concentration of walruses there in the summer that actively feed on the abundance of molluscs, crustaceans, polychaete worms, and other benthic fauna.

Oceanographers attribute the high productivity of Hanna Shoal, and the northeastern Chukchi Sea shelf in general, to the unique physics that steer highly productive water masses into the region, the relatively shallow average depth (42 m on the northeastern Chukchi Shelf), and weak grazing pressure from low zooplankton abundance during spring. These factors facilitate the deposition of a large proportion of pelagic primary production to the seabed, thus providing a major carbon subsidy to the benthic food web. The result is an extraordinary high diversity and biomass of benthic fauna that coincides with high water column chlorophyll a in localized "hotspots" of the Chukchi Sea. Benthic grabs revealed chlorophyll a concentrations among the highest ever reported in marine sediments (up to 665 mg m-2) and levels varied depending on the overlying water mass type.

Estimates of epibenthic and infaunal organisms around Hanna Shoal, collected using plumb staff beam trawls and van Veen grabs (respectively), were enormous. Epibenthic assemblages ranged to 500 g m-2 (and thousands of individuals m-2); infaunal biomass and abundances approached 820 g m-2 and 5,500 individuals m-2, respectively. In both sampling years, the greatest biomass was not on the Shoal itself, but on its northwest and southeast flanks (or both), which receive Bering Sea water that originates in the North Pacific.

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NE Chukchi Sea Moored Ecosystem Observatory

Funding provided by Alaska Ocean Observing System, North Pacific Research Board, Olgoonik-Fairweather, University of Alaska Fairbanks, Université Laval, and University of Washington

A multi-institutional, multi-investigator partnership operates and maintains a subsurface moored observatory on the NE Chukchi shelf near 71.6N, 161.5W. The first deployment occurred in September 2014 and the mooring will be re-deployed annually through at least 2018.

The instruments record with high temporal resolution throughout the year, including the under-sampled and poorly understood seasons when sea ice typically inhibits ship-based sampling. Measurements include ice, ocean physics, nutrient and carbonate chemistry, particulate matter, phytoplankton, zooplankton, fisheries, and marine mammal datasets, thereby providing multifaceted views into the inter-trophic co-variability of the Chukchi shelf ecosystem. The scientific objectives of this monitoring effort are to:

1. Quantify hourly, daily, seasonal, annual, and inter-annual variations in selected physical, chemical, and biological measurement parameters on the shallow Chukchi Sea continental shelf.
2. Relate the timing and magnitude of fluctuations in nutrient and carbonate chemistry, particulate, and fish/zooplankton parameters to the current field and the physical hydrography, wind, light, and ice environment.
3. Provide researchers and resource managers with a broad-spectrum and multi-year set of reference observations that can be applied to evaluating and improving regional and global-scale biogeochemical, ice-ocean circulation, ecosystem, and stock-assessment models.

The observatory consortium welcomes new partners, new applications of the data already being collected, and new instrumentation that can further enhance the value of the existing efforts.

In accordance with the NPRB data policy, all data collected on this mooring are publicly available. There will be two data releases associated with each dataset. The first will come immediately after the recovery

cruise and will include raw, unprocessed, data for users with time-sensitive applications. The second release includes fully processed data following requisite calibrations, application of calibration coefficients, and editing, typically within ~6 months of mooring recovery. Additional details about the mooring configuration, data policy, and the observatory consortium are available online at: http://mather.sfos.uaf.edu/~seth/CEO.

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Northern Bering Sea bottom trawl survey

Funding provided by National Oceanic and Atmospheric Administration

Biennial northern Bering Sea (NBS) shelf surveys will start in 2017. This survey will provide long-term monitoring of bottom fishes, crabs, and other demersal macrofauna to help provide a better understanding of how biota and the ecosystem are responding to climate change and loss of sea ice. The ultimate goal is a long time-series of standardized data collections that will provide quantitative indices of abundance for determining how climate change is affecting population trends and community structure. The expanded survey data collections from the NBS will also augment those from the eastern Bering Sea (EBS) shelf and provide new insight into the spatial and temporal response of bottom fish and crab populations to highly variable interannual ice cover and summer bottom temperatures across the entire eastern Bering Sea shelf. Digital data are available online (http://www.afsc.noaa.gov/RACE/groundfish/survey_data/data.htm).

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Northern Bering Sea BASIS (Bering-Arctic Subarctic Integrated Survey)

Funding provided by National Oceanic and Atmospheric Administration

The northern Bering Sea BASIS survey will continue in 2016 and 2018. These surveys will assess the relative abundance, size, and energetic status of late summer/early fall fish species such as western Alaska juvenile Chinook and chum salmon, capelin, herring, juvenile pollock, and saffron cod. Bio/physical oceanographic data will also be collected to assess the impact of climate change and variability on the ecosystem. When combined with the southeastern Bering Sea BASIS survey, the resulting survey effort will cover much of the eastern Bering Sea shelf. Digital data are available from the program leader Ed Farley.

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Chukchi Ecology and Seal Survey (CHESS)

Funding provided by National Oceanic and Atmospheric Administration

A comprehensive survey for the abundance and distribution of bearded and ringed seals in the Chukchi Sea will be conducted in 2016. In collaboration with the U.S. Fish and Wildlife Service, the objectives may be expanded to include polar bears. The survey will be based on coupled infrared and color imagers. Animals will be detected by infrared video and the species will be identified from high-resolution color

photographs, a method demonstrated to be highly effective in recent surveys of the Bering Sea pack ice zone. Because large portions of the bearded and ringed seal populations use the Russian waters of the western Chukchi Sea, the survey will require collaboration with the Russian Federation. The Chukchi survey will complement the results of the Bering Sea survey, leaving only the Beaufort Sea as a gap in complete estimates of the breeding populations of ice seals in the seas surrounding Alaska.

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Influence of sea ice on ecosystem shifts in Arctic seas

Funding provided by U.S. Geological Survey Changing Arctic Ecosystems Initiative

The decline of Arctic sea ice is predicted to promote an ecosystem shift from benthic-dominated to pelagic-dominated communities on Arctic shelves, raising concern for species like walrus and eiders that feed on benthic organisms. Sea ice dynamics are thought to support a rich benthic ecosystem by promoting the export of surface primary production to the ocean floor. As sea ice extent diminishes, more prolonged open-water phytoplankton blooms and increased zooplankton grazing may increasingly route surface primary production to pelagic consumers. The pace of declining benthic production has been difficult to quantify, leaving resource managers with much uncertainty. We propose to relate annually resolved growth increments in benthic bivalves with satellite derived sea ice records to develop a predictive relationship between sea ice and benthic production. Bivalves are a key prey item for both walrus and eiders. The relative contributions of sea ice algae and phytoplankton, the two major sources of surface primary production, will also be described for bivalves using stable isotope analysis. Changes in bivalve size will be converted to differences in caloric content available to predators. Combining these products with model projections of future sea ice cover will allow us to predict the pace of shifts in benthic production, clarify the underlying mechanism, and enhance forecasts of the population response of Department of Interior managed species to a changing Arctic environment. (Funded FY2014-FY2019)

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Regional Arctic System Model (RASM)

Funding provided by U.S. Office of Naval Research

The Regional Arctic System Model (RASM) has been developed to advance capability in simulating critical physical processes, feedbacks and their impact on the Arctic climate system and to reduce uncertainty in its prediction. RASM is a limited-area, fully coupled ice-ocean-atmosphere-land model that uses the Community Earth System Model (CESM) framework. It includes the Weather Research and Forecasting (WRF) model, the LANL Parallel Ocean Program (POP) and Community Ice Model (CICE) and the Variable Infiltration Capacity (VIC) land hydrology model. In addition, a streamflow routing (RVIC) model was recently implemented in RASM to transport the freshwater flux from the land surface to the Arctic Ocean. Finally, marine biogeochemistry components are currently being implemented in the ocean and sea ice components to expand RASM capability into Arctic ecosystem studies. The model domain is configured at horizontal resolution of 1/12° (or ~9km) for the ice-ocean and 50 km for the atmosphere-land model components. It covers the entire Northern Hemisphere marine cryosphere,

terrestrial drainage to the Arctic Ocean and its major inflow and outflow pathways, with optimal extension into the North Pacific / Atlantic to model the passage of cyclones into the Arctic. All RASM components are coupled at high frequency to realistically represent interactions among model components at inertial and longer time scales.

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Arctic Coastal Ecosystem Survey (ACES)

Funding provided by North Pacific Research Board (project 1229), Bureau of Ocean Energy Management, National Oceanic and Atmospheric Administration, and North Slope Borough/Shell Baseline Studies Program

In response to a rapidly changing Arctic, we developed a multi-faceted approach to examine variation in community structure and trophodynamics of nearshore arctic nekton during the ice-free season of 2013 and 2014. Fish samples were collected weekly via beach seine at 12 stations surrounding Pt. Barrow in three water bodies (Chukchi, Beaufort, Elson Lagoon) from ice breakup (early July) until late August in 2013 and 2014 (also planned for 2015). Juvenile and larval stages (98%) comprise the majority of catch data suggesting nearshore areas might serve as nursery habitat similar to those in similar lower latitude systems. The Elson Lagoon is dominated by euryhaline and amphidromous species, whereas the Beaufort and Chukchi Sea stations were dominated by marine species. Several species of sculpin are common but rarely abundant throughout all sites; catch data from 2007-2009 and 2012-2014 show that availability of high quality forage species (capelin and Pacific sand lance) in the nearshore is linked to fluctuations in temperature, salinity and turbulence. A laboratory study has examined the temporal scale of tissue turnover for nitrogen and carbon stable isotopes, using Arctic sculpin. Results will offer insight into the rates of change in tissue and how landfast ice breakup alter foodweb structure. These different approaches will offer a better understanding of important drivers of spatiotemporal variability in nearshore foodwebs and improve the ability to predict how these systems may shift in the face of Arctic climate change.

Coincident with biological collections was a series of meteorological and oceanographic observations within Elson Lagoon and at the interface between the lagoon and the Beaufort Sea. The primary rationale for these observations was to link the meteorological and hydrodynamic conditions to changes in the biological community. To examine temporal patterns, an ADCP was moored in the inlet between Elson Lagoon and the Beaufort Sea during ice free periods of both 2013 and 2014 (also planned for 2015). Additionally, several mobile ADCP surveys were conducted within this inlet as well as the inlet between Elson Lagoon and North Salt Lagoon near Barrow to characterize flow dynamics between adjacent water bodies. These measurements were linked to a nearby meteorological station to examine coupling from atmospheric and oceanographic processes at local scales. Based on preliminary analyses, responses in the biological community are likely mediated by the strong dependence of physical controls, both meteorological and hydrodynamic, and suggest variation in the temporal and spatial patterns.

For more information about the project, see http://boswelllab.wix.com/boswelllab#!aces-project-summary/ce65.

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Tracing sea ice algae in Arctic benthic food webs using the sea ice diatom biomarker IP25

Funding provided by North Pacific Research Board (project 1503)

Sea ice cover over the Chukchi Sea shelf is continually decreasing with a warming climate and the effects on primary production regimes, especially sea ice algal production and subsequently benthic food webs are still uncertain. Here we propose to use IP25 as an ice-algal specific tracer to reliably track sea ice algal sources in the Chukchi Sea benthic food web and to distinguish ice algae from other production sources such as pelagic phytoplankton. We will combine the IP25 tracer use with the sterol brassicasterol as a biomarker for phytoplankton to identify the relative proportions of sea ice algae (IP25) and phytoplankton (brassicasterol) in consumer diets (PIP25 ratio). Benthic bivalves and polychaetes are used as representatives of benthic food web consumers for their prominence in benthic communities and their wide variety of feeding types. We will use stable carbon isotope composition of dissolved inorganic carbon and of IP25 in sea ice algae, surface sediments and benthic consumers to ground-truth the sea ice origin of IP25 and its specificity for ice algae. This work can significantly advance our ability to project changes in the primary production regime to subsequent lower and higher trophic levels. Many of these higher trophic levels such as walrus and spectacled eiders are of subsistence interest to Alaska Native peoples, and knowledge gleaned from this project can enhance our understanding how these subsistence resources may be affected with continued climate warming.

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Assessing the role of oceanic heat fluxes on ice ablation on the Chukchi Sea Shelf

Funding provided by North Pacific Research Board (project 1504)

This proposal seeks to understand the role of oceanic heat flux convergences in the summertime retreat of sea ice over the central Chukchi Sea. It is motivated by observations and preliminary numerical model results indicating that eddies generated along the marginal ice zone front carry substantial quantities of heat laterally beneath the ice. The lateral eddy heat flux is via intrusions of warm water into the pycnocline separating cold, dilute surface meltwaters and near-freezing, salty bottom waters. This process is potentially important in heating the underside of the ice and thus enhancing summer ice melt and retreat. In addition, the mean summer currents in the Central Channel may be thermodynamically important in the summertime retreat of sea ice directly and, indirectly, as a source of the eddies to other portions of the shelf. This project will support one graduate student and use an ocean-ice circulation model to: 1) determine the proportion of ice melt due to the vertical heat flux from the ocean with that due to the net airsea heat flux at the ice surface; 2) evaluate the role of intra-pycnocline eddies versus the mean flow in providing this sub-surface heat flux; and 3) evaluate the role of winds in modifying the subsurface heat flux to the ice. Outreach consists of developing digital model animations (and explanations) for use in schools and communities to explain how the ocean affects sea ice melt in the Chukchi Sea. The content will be directed at junior high and high school audiences. Weingartner's role on the North Slope Borough-Shell Baseline Studies Science Steering Committee (SSC) will assist in outreach. The SSC includes representatives from six NSB villages and meets four times/year. He will use these meetings to inform the village representatives and present to the communities.

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Growth and dispersal of early life history stages of Arctic cod and saffron cod under variable climate forcing

Funding provided by North Pacific Research Board (project 1508)

We propose to develop a biophysical transport model to simulate the dispersal of early life history stages of the two most abundant fish species, Arctic cod (Boregadus saida) and saffron cod (Eleginus gracilis), in the Chukchi Sea and Beaufort Sea. These species form a crucial link from lower trophic levels to seabirds, marine mammals, and humans and have been recognized as potential target species for new fisheries in the Arctic. We combine observations of late larval and early juvenile stages of both species during the summer of 2012 and 2013 with laboratory-derived estimates of their temperature-dependent growth to parameterize an individual particle tracking model (TRACMASS) that includes growth and vertical movement. The model will be linked to a recently developed pan-arctic ocean circulation model (PAROMS) to test hypotheses about the origin and fate of young-of-the-year Arctic and saffron cod. Specifically, we aim to (1) identify likely spawning locations by tracking particles backward in time from known summer aggregations in the Chukchi Sea and (2) simulate pathways of dispersal from these aggregations to downstream nursery areas, which may include areas in the Beaufort Sea. Improved understanding of the growth, distribution, and movements of early life history stages of Arctic cod and saffron cod in the region, and of the connectivity between the Chukchi Sea and Beaufort Sea, has several immediate and long-term benefits. It directly addresses research priorities identified in the Arctic Fisheries Management Plan, enhances required descriptions of Essential Fish Habitat for two key prey species, and provides benchmarks against which to assess future changes to the Arctic marine ecosystem that may result from new development in the Arctic and from anthropogenic climate change.

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Glider based real-time monitoring of marine mammals in the Arctic

Funding provided by North Pacific Research Board (project 1515)

Shipboard observations of marine mammal distribution and habitat are expensive and logistically challenging to collect in Arctic waters. Port facilities are minimal and access to appropriate vessels for spending extended periods of time at sea is extremely limited. Autonomous platforms like gliders provide the capability to collect both oceanographic and passive acoustic data for far longer periods of time (weeks to months) and at significantly reduced costs than traditional shipboard or aerial surveys. We have developed a system to record, detect, classify, and remotely report Arctic and sub-Arctic marine mammal calls in real time from Slocum ocean gliders based on the digital acoustic monitoring (DMON) instrument and the low-frequency detection and classification system (LFDCS). The system has been used several times in the northwest Atlantic Ocean and was successfully demonstrated for Arctic research during two pilot studies in the Chukchi Sea during September 2013 and 2014. Deployments to date have been short (1-3 weeks), but the capability exists for much longer missions. Our objective is to conduct an 8-10 week survey of the northeastern Chukchi Sea using a G2 Slocum glider to (1) examine the distribution, occurrence, and habitat of marine mammals using in-situ passive acoustic and oceanographic data collected by the glider, and (2) demonstrate the near real-time detection and reporting capability of the system. We hypothesize that some Arctic species associate with a front separating Bering Sea water and Alaska Coastal Current water to take advantage of aggregations of either pelagic or benthic prey. We

further hypothesize that marine mammal community composition will change predictably with the strong spatial variability in oceanographic properties found in this region. We anticipate that these predictions will improve efforts to (1) mitigate impacts on marine mammals by human activities and (2) forecast changes in species distributions caused by climate change.

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Northern Alaska Sea Ice Project Jukebox, Phase II

Funding provided by North Pacific Research Board (project 1521)

The project examines the complex interrelationship between people and their environment as it relates to nearshore and shorefast sea ice and humans having to continually adapt responses to changes in ice conditions. Also addressed is how climate change is affecting the ecosystems, which in turn affect the local people. This project tells the story of the changing Arctic through those who live within it daily.

Building upon the Northern Alaska Sea Ice Project Jukebox website (www.jukebox.uaf.edu/seaice) researchers can listen to recordings made in 1978, 2008, 2009, and 2013 with local experts in Barrow and other northern Alaska communities talking about their local traditional knowledge about and observations of changing sea ice. Conducting interviews in 2015 in Barrow will provide continuity in documentation of changing nearshore sea ice conditions and of "unusual" years. This expanding record is useful to researchers trying to understand the ice environment as well as social scientists studying human adaptation, decision making, and risk taking behavior. Conducting similar interviews in Kotzebue will begin documentation of traditional knowledge of nearshore and shorefast sea ice there. This will serve as both a comparative dataset for a location with vastly different ice conditions than Barrow, and as the start of another longitudinal research plan in that area.

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NOAA Office of Exploration and Research

In FY15, NOAA Office of Exploration and Research will be supporting exploration projects in the Chukchi Borderlands. Three two-year projects are presently considered for funding. The field work for these projects is expected to take place in the August-September 2016 time frame. For more information please contact John McDonough at john.mcdonough@noaa.gov, Jeremy Potter at jeremy.potter@noaa.gov or Nathalie Valette-Silver at Nathalie.Valette-Silver@noaa.gov.

'Pacification' of the Arctic: Climate change impacts on the eggs and larvae of Alaskan gadids

Funding provided by North Pacific Research Board (project 1403)

Both Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis)* play a crucial role in the Arctic by channeling energy between plankton and higher level marine mammals and seabird in a moderately simple pelagic, ice-dominated food web. Both cod species have physiology adapted for their cold-water environment, but may not be able to compete with other gadids invading northward i.e., Pacific cod, *Gadus macrocephalus* and walleye pollock, *Gadus chalcogramma*. For example, earlier experimental

work from NPRB project #1228 indicated dramatic differences in the thermal optima within and among gadids from each region during the juvenile stage. However, the thermal sensitivity of dispersive egg and larval stages is unknown, yet could be the key component governing current and future biogeography of gadids in Alaskan waters.

This project uses the multi-species broodstock program at the Alaska Fisheries Science Center's 20,000 sq. ft. cold-water laboratory at the Hatfield Marine Science Center. Gadids include mature individuals from collections of juvenile Arctic and saffron cod (2012, 2013, 2014) and Pacific cod and walleye pollock (2005 – present). The first successful mass-scale spawning and larviculture of Arctic cod was completed during the spring of 2015. Current experiments are examining how variability in temperature and food availability influences growth, development, lipid storage and survival at these early, critical life stages in all four gadid species. Data from these common garden experiments will be used to predict future effects of warming on fish distribution and energetic impacts on food webs in the Arctic. Temperature-dependent growth and development data from these experiments are also being used to parameterize the individual particle tracking model (TRACMASS) for NPRB project #1508.

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Sustainability of critical areas for eiders and subsistence hunters in an industrializing nearshore zone

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Throughout the Arctic, indigenous people are faced with difficult choices between the economic benefits of industrialization versus associated threats to subsistence hunting. Evaluating alternatives is especially challenging when climate change is likely to shift the location and quality of habitats, as well as the ice conditions that govern access to those habitats by both animals and hunters. In the Chukchi Sea, anticipated infrastructure to support offshore oil wells, including a major pipeline, will be placed in a nearshore corridor used by most marine birds and mammals that migrate to the western Arctic. Such industrial development can provide employment for local residents and tax revenue for local governments, but should minimize potential impacts on subsistence species. In this research, we are modeling habitat requirements and mapping viable prey densities for commonly hunted sea ducks in the Chukchi nearshore corridor (10 to 40 m depth), and assessing long-term variations in accessibility of those feeding areas through the ice. We are supplementing these habitat maps with long-term delineations of the landfast ice edge along which much of the eider hunting occurs. In parallel with this representative study of potential shifts in habitat and hunter accessibility, we are conducting workshops based on methods of structured decision analysis in the village of Wainwright. These workshops will help create a local vision for sustainability, in terms of potential risks to subsistence hunting and related lifestyles versus economic benefits of different development scenarios.

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